

## CLAIMS

1. A system for enabling a wireless communication terminal present in a local area to communication with a network outside  
5 the local area, the system comprising:

a plurality of sub-stations for forming respective wireless communication areas individually in the local area, and performing wireless communication with the wireless communication terminal in the respective corresponding wireless communication areas;

10 one or more access relay apparatuses for converting a signal to be input from an outside of the local area to an inside of the local area to a signal form for use in the local area, and converting a signal to be output from the inside of the local area to the outside of the local area to a signal form for use in the outside  
15 of the local area; and

a main station provided between the sub-stations and the access relay apparatuses,

wherein the main station comprises:

a managing means for managing a communication route  
20 from each of the access relay apparatuses to each of the sub-stations in a state such that the communication route can be set; and

a selecting means for selecting and outputting a signal which is input from the outside of the local area, whose form is converted in each of the access relay apparatuses, and which is  
25 input to the local area, to the corresponding sub-station in

accordance with the communication routes managed by the managing means.

2. The wireless communication system according to claim 1,  
5 wherein the selecting means further comprises:

one or more splitting means corresponding to the respective access relay apparatuses; and

a plurality of switching means corresponding to the respective sub-stations,

10 each of the splitting means splits and outputs the signal to be input to the local area whose form has been converted in the access relay apparatus, to all of the switching means, and

each of the switching means is switched to determine which of the signals output from the splitting means is output to the  
15 corresponding sub-station based on the communication routes managed by the managing means.

3. The wireless communication system according to claim 2,  
wherein each of the access relay apparatuses converts the signal  
20 to be input to the local area to the signal form for use in the local area using frequencies different from one another,

the selecting means further comprises a plurality of multiplexing means corresponding to the respective switching means,  
and

25 each of the multiplexing means frequency-multiplexes a

signal output from the corresponding switching means to create a multiplexed signal to be input to the local area and outputs the multiplexed signal to the corresponding sub-station.

5           4. The wireless communication system according to claim 3, wherein the splitting means comprises a coupler for splitting a single signal into a plurality of signals, and

          the multiplexing means comprises a coupler for combining a plurality of signals into a single signal.

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          5. The wireless communication system according to claim 1, further comprising a network switch provided between the access relay apparatuses and the network outside the local area, wherein

          the network switch manages a state of connection between  
15 each of the access relay apparatus and the wireless communication terminal present in the local area, specifies the wireless communication terminal present in the local area with reference to a signal input to the network switch, and based on the connection state, outputs the signal input to the network switch to the access  
20 relay apparatus connected to the specified wireless communication terminal.

          6. The wireless communication system according to claim 5, wherein the wireless communication terminal present in the local  
25 area transmits a signal to be transmitted to another wireless

communication terminal present in the local area, to the sub-station of the communication area to which the wireless communication terminal belongs,

the signal to be transmitted to the other wireless communication terminal is input via the sub-station and the main station to the access relay apparatus, is converted to a signal for use in the outside of the local area in the access relay apparatus, and is output to the network switch, and

the network switch specifies the other wireless communication terminal present in the local area with reference to the signal whose form has been converted in the access relay apparatus, and based on the connection state, outputs the signal input to the network switch to the access relay apparatus connected to the specified wireless communication terminal.

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7. The wireless communication system according to claim 1, wherein each of the sub-stations receives the signal to be output from the inside of the local area to the outside of the local area, the signal being transmitted from the wireless communication terminal, and outputs the signal to the main station,

the main station outputs the signal to be output from the inside of the local area to the outside of the local area, the signal being output from the sub-station, to the access relay apparatus,

the access relay apparatus converts the signal to be output

from the inside of the local area to the outside of the local area, the signal being output from the main station, to the signal form for use in the outside of the local area, and outputs the converted signal to the outside of the local area.

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8. The wireless communication system according to claim 7, wherein the main station further comprises:

a plurality of main station signal receiving means corresponding to the respective sub-stations, for receiving the  
10 signal to be output from the inside of the local area to the outside of the local area, the signal being output from each of the sub-station; and

a main station combining means for combining the signals to be output from the inside of the local area to the outside of  
15 the local area, the signals being received by the plurality of the main station signal receiving means, and outputting the combined signal to the access relay apparatus.

9. The wireless communication system according to claim 7,  
20 wherein the access relay apparatus further comprises:

an intensity detecting means for detecting an intensity of a signal transmitted from the main station; and

a request means for requesting the main station to switch one signal to be transmitted to the access relay apparatus to another  
25 signal when the intensity of the signal transmitted from the main

station, the intensity being detected by the intensity detecting means, is lower than a predetermined value,

when the request from the request means is present and the main station receives a signal having the same contents to be  
5 transmitted to the access relay apparatus from two or more of the sub-stations, the main station outputs the signal output from one of the two or more sub-stations, the one sub-station being different from the sub-station being outputting the signal to the access relay apparatus, instead of the signal being output to the access  
10 relay apparatus.

10. The wireless communication system according to claim 7, wherein each of the sub-stations further comprises a crosstalk canceling means for creating a signal having the same intensity  
15 as that of crosstalk occurring in the signal to be output from the inside of the local area to the outside of the local area due to an influence of the signal to be input to the local area, based on the signal to be input to the local area, and inverting the signal having the intensity and adding the inverted signal to the  
20 crosstalk.

11. The wireless communication system according to claim 10, wherein the crosstalk canceling means comprises:

a first coupler section for splitting a portion of the signal  
25 to be input to the local area; and

a second coupler section for combining the portion of the signal to be input to the local area which has been split by the first coupler section, with the signal to be output from the inside of the local area to the outside of the local area,

5        the first coupler section changes a phase of a signal to be output to the second coupler section by  $90^\circ$  when splitting the signal to be input to the local area, and

      the second coupler section changes a phase of the signal to be input to the local area which has been output from the first  
10    coupler section, by  $90^\circ$ , when combining the two signals.

12. The wireless communication system according to claim 7, wherein, in each of the sub-station, a signal transmitting/receiving system for outputting the signal to be  
15    output from the inside of the local area to the outside of the local area, the signal being output from the wireless communication terminal, to the main station, and a signal transmitting/receiving system for transmitting the signal to be input to the local area, the signal being output from the main station, to the wireless  
20    communication terminal, are accommodated in respective separate housings.

13. The wireless communication system according to claim 1, wherein the main station and each of the sub-stations are connected  
25    via an optical transmission line,

the main station further comprises an optical signal conversion means for converting the signal selected by the selecting means to an optical signal,

each of the sub-stations converts the optical signal output  
5 from the main station to an electrical signal in a form for use in the local area, and transmits the electrical signal in the form of a wireless radio wave to the wireless communication terminal in the corresponding wireless communication area.

10 14. The wireless communication system according to claim 13, wherein the main station further comprises a main station frequency-converting means for converting a frequency of the signal selected by the selecting means to an intermediate frequency, and  
the optical signal conversion means converts the signal  
15 frequency-converted by the main station frequency-converting means to an optical signal.

15 15. The wireless communication system according to claim 14, wherein the sub-station further comprises a sub-station  
20 frequency-converting means for converting a frequency of the converted electrical signal in the form for use in the local area from the intermediate frequency to a frequency which is when the access relay apparatus has output the electrical signal, and  
the signal frequency-converted by the sub-station  
25 frequency-converting means is transmitted in the form of a wireless



radio wave to the wireless communication terminal in the corresponding wireless communication area.

16. The wireless communication system according to claim 13,  
5 wherein the main station further comprises a main station frequency-converting means for converting a frequency of the signal to be input to the local area, a form of the signal having been converted by each of the access relay apparatuses, to an intermediate frequency,

10 the selecting means selects the signal to be input to the local area whose form has been converted by each of the access relay apparatuses and which has been frequency-converted by the main station frequency-converting means.

15 17. The wireless communication system according to claim 13, wherein each of the access relay apparatuses outputs the converted signal to be input to the local area as a signal having a first intermediate frequency to the main station,

the main station further comprises a main station  
20 frequency-converting means for converting a frequency of the signal to be input to the local area, the signal being output from each of the access relay apparatuses, to a second intermediate frequency, and

the selecting means selects the signal to be input to the  
25 local area whose having been converted by each of the access relay

apparatuses and which has been frequency-converted by the main station frequency-converting means.

18. The wireless communication system according to claim 13,  
5 wherein the optical transmission lines connecting the respective sub-stations and the main station have lengths substantially equal to one another.

19. The wireless communication system according to claim 1,  
10 wherein the main station and each of the sub-stations are connected via an optical transmission line,

the main station further comprises an optical signal conversion means for converting the signal to be input to the local area, a form of the signal having been converted by each of the  
15 access relay apparatuses, to an optical signal, and

the selecting means selects and outputs the optical signal converted by the optical signal conversion means to the sub-station.

20 20. The wireless communication system according to claim 1, wherein the main station further comprises a plurality of signal receiving means corresponding to the respective sub-stations, for receiving all signals which are output from the respective access relay apparatuses,

25 the selecting means comprises:

a plurality of splitting means corresponding to the respective sub-stations; and

a plurality of selecting/outputting means provided between the respective sub-stations and the respective splitting  
5 means,

the splitting means split all of the signals to be input to the local area which have been output from the respective access relay apparatuses and have been received by the respective signal receiving means, into signals to be input to the local area for  
10 the respective access relay apparatuses, and

each of the selecting/outputting means outputs the signal to be input to the local area which is to be output to the corresponding sub-station, among the signals to be input to the local area which have been split by the corresponding splitting  
15 means, to the corresponding sub-station based on the communication routes managed by the managing means.

21. The wireless communication system according to claim 1, wherein the selecting means comprises:

20 a plurality of signal receiving means corresponding to the respective sub-stations; and

a plurality of selecting/outputting means provided between the respective sub-stations and the respective signal receiving means,

25 each of the signal receiving means receives only the signal

to be input to the local area which is to be transmitted to the corresponding sub-station, among the signals to be input the local area which have been output from the respective access relay apparatuses, based on the communication routes managed by the managing means, and

the selecting/outputting means transmit the signal to be input to the local area which has been received by the respective signal receiving means, to the respective corresponding sub-station.

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22. The wireless communication system according to claim 1, wherein the wireless communication terminal present in the local area comprises a communication start request means for requesting for starting communication via the desired access relay apparatus to the sub-station in the communication area to which the wireless communication terminal belongs,

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the communication start request reaches via the sub-station to the main station,

the main station comprises:

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a communication request signal receiving means for receiving the communication start request transmitted from the communication start request means; and

a communication starting means for starting communication via the access relay apparatus desired by the sub-station based on the communication start request received by

25

the communication request signal receiving means.

23. The wireless communication system according to claim 1,  
wherein the selecting means does not select or output the signal  
5 output by the access relay apparatus to the sub-station when the  
sub-station has not transmitted a signal to the access relay  
apparatus for a predetermined period of time or more.

24. A system for enabling a wireless communication terminal  
10 present in a local area to communication with a network outside  
the local area, the system comprising:

a plurality of sub-stations for forming respective wireless  
communication areas individually in the local area, and performing  
wireless communication with a wireless communication terminal in  
15 the respective corresponding wireless communication areas;

one or more access relay apparatuses for converting a signal  
to be input from an outside of the local area to an inside of the  
local area to a signal form for use in the local area, and converting  
a signal to be output from the inside of the local area to the  
20 outside of the local area to a signal form for use in the outside  
of the local area; and

a main station provided between the sub-stations and the  
access relay apparatuses,

wherein the main station comprises a selecting means for  
25 selecting and outputting the signal to be input to the local area,

the signal having been input from an outside of the local area and a form of the signal having been converted in the access relay apparatus, to all of the sub-stations.

5           25. The wireless communication system according to claim 24, wherein a plurality of access relay apparatuses are connected to the main station,

the main station further comprises a multiplexing means for frequency-multiplexing the signal to be input to the local area,  
10 the signal being output from the access relay apparatus, and

the signal to be input to the local area which has been multiplexed by the multiplexing means, is selected and output to all of the sub-stations.

15           26. The wireless communication system according to claim 24, further comprising a network switch provided between the access relay apparatuses and the network outside the local area, wherein

the network switch manages a state of connection between each of the access relay apparatus and the wireless communication  
20 terminal present in the local area, specifies the wireless communication terminal present in the local area with reference to a signal input to the network switch, and based on the connection state, outputs the signal input to the network switch to the access relay apparatus connected to the specified wireless communication  
25 terminal.

27. The wireless communication system according to claim 26,  
wherein the wireless communication terminal present in the local  
area transmits a signal to be transmitted to another wireless  
5 communication terminal present in the local area, to the  
sub-station of the communication area to which the wireless  
communication terminal belongs,

the signal to be transmitted to the other wireless  
communication terminal is input via the sub-station and the main  
10 station to the access relay apparatus, is converted to a signal  
for use in the outside of the local area in the access relay apparatus,  
and is output to the network switch, and

the network switch specifies the other wireless  
communication terminal present in the local area with reference  
15 to the signal whose form has been converted in the access relay  
apparatus, and based on the connection state, outputs the signal  
input to the network switch to the access relay apparatus connected  
to the specified wireless communication terminal.

20 28. The wireless communication system according to claim 24,  
wherein each of the sub-stations receives the signal to be output  
from the inside of the local area to the outside of the local area,  
the signal being transmitted from the wireless communication  
terminal, and outputs the signal to the main station,

25 the main station outputs the signal to be output from the

inside of the local area to the outside of the local area, the signal being output from the sub-station, to the access relay apparatus,

the access relay apparatus converts the signal to be output  
5 from the inside of the local area to the outside of the local area, the signal being output from the main station, to the signal form for use in the outside of the local area, and outputs the converted signal to the outside of the local area.

10 29. The wireless communication system according to claim 28, wherein the main station further comprises:

a plurality of main station signal receiving means corresponding to the respective sub-stations, for receiving the signal to be output from the inside of the local area to the outside  
15 of the local area, the signal being output from each of the sub-station; and

a main station combining means for combining the signals to be output from the inside of the local area to the outside of the local area, the signals being received by the plurality of  
20 the main station signal receiving means, and outputting the combined signal to the access relay apparatus.

30. The wireless communication system according to claim 28, wherein the access relay apparatus further comprises:

25 an intensity detecting means for detecting an intensity of



a signal transmitted from the main station; and

a request means for requesting the main station to switch one signal to be transmitted to the access relay apparatus to another signal when the intensity of the signal transmitted from the main station, the intensity being detected by the intensity detecting means, is lower than a predetermined value, and

when the request from the request means is present and the main station receives a signal having the same contents to be transmitted to the access relay apparatus from two or more of the sub-stations, the main station outputs the signal output from one of the two or more sub-stations, the one sub-station being different from the sub-station being outputting the signal to the access relay apparatus, instead of the signal being output to the access relay apparatus.

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31. The wireless communication system according to claim 28, wherein each of the sub-stations further comprises a crosstalk canceling means for creating a signal having the same intensity as that of crosstalk occurring in the signal to be output from the inside of the local area to the outside of the local area due to an influence of the signal to be input to the local area, based on the signal to be input to the local area, and inverting the signal having the intensity and adding the inverted signal to the crosstalk.

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32. The wireless communication system according to claim 31,  
wherein the crosstalk canceling means comprises:

a first coupler section for splitting a portion of the signal  
to be input to the local area; and

5 a second coupler section for combining the portion of the  
signal to be input to the local area which has been split by the  
first coupler section, with the signal to be output from the inside  
of the local area to the outside of the local area,

the first coupler section changes a phase of a signal to  
10 be output to the second coupler section by  $90^\circ$  when splitting the  
signal to be input to the local area, and

the second coupler section changes a phase of the signal  
to be input to the local area which has been output from the first  
coupler section, by  $90^\circ$ , when combining the two signals.

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33. The wireless communication system according to claim 28,  
wherein, in each of the sub-station, a signal  
transmitting/receiving system for outputting the signal to be  
output from the inside of the local area to the outside of the  
20 local area, the signal being output from the wireless communication  
terminal, to the main station, and a signal transmitting/receiving  
system for transmitting the signal to be input to the local area,  
the signal being output from the main station, to the wireless  
communication terminal, are accommodated in respective separate  
25 housings.

34. The wireless communication system according to claim 24,  
wherein the main station and each of the sub-stations are connected  
via an optical transmission line,

5        the main station further comprises an optical signal  
conversion means for converting the signal selected by the  
selecting means to an optical signal,

each of the sub-stations converts the optical signal output  
from the main station to an electrical signal in a form for use  
10 in the local area, and transmits the electrical signal in the form  
of a wireless radio wave to the wireless communication terminal  
in the corresponding wireless communication area.

35. The wireless communication system according to claim 34,  
15 wherein the main station further comprises a main station  
frequency-converting means for converting a frequency of the signal  
selected by the selecting means to an intermediate frequency, and

the optical signal conversion means converts the signal  
frequency-converted by the main station frequency-converting  
20 means to an optical signal.

36. The wireless communication system according to claim 35,  
wherein the sub-station further comprises a sub-station  
frequency-converting means for converting a frequency of the  
25 converted electrical signal in the form for use in the local area

from the intermediate frequency to a frequency which is when the access relay apparatus has output the electrical signal, and

the signal frequency-converted by the sub-station frequency-converting means is transmitted in the form of a wireless radio wave to the wireless communication terminal in the corresponding wireless communication area.

37. The wireless communication system according to claim 34, wherein the main station further comprises a main station frequency-converting means for converting a frequency of the signal to be input to the local area, a form of the signal having been converted by each of the access relay apparatuses, to an intermediate frequency, and

the selecting means selects the signal to be input to the local area whose form has been converted by each of the access relay apparatuses and which has been frequency-converted by the main station frequency-converting means.

38. The wireless communication system according to claim 34, wherein each of the access relay apparatuses outputs the converted signal to be input to the local area as a signal having a first intermediate frequency to the main station,

the main station further comprises a main station frequency-converting means for converting a frequency of the signal to be input to the local area, the signal being output from each

of the access relay apparatuses, to a second intermediate frequency,  
and

the selecting means selects the signal to be input to the  
local area whose form has been converted by each of the access  
5 relay apparatuses and which has been frequency-converted by the  
main station frequency-converting means.

39. The wireless communication system according to claim 34,  
wherein the optical transmission lines connecting the respective  
10 sub-stations and the main station have lengths substantially equal  
to one another.

40. The wireless communication system according to claim 24,  
wherein the main station and each of the sub-stations are connected  
15 via an optical transmission line,

the main station further comprises an optical signal  
conversion means for converting the signal to be input to the local  
area, a form of the signal having been converted by each of the  
access relay apparatuses, to an optical signal, and

20 the selecting means selects and outputs the optical signal  
converted by the optical signal conversion means to the  
sub-station.

41. The wireless communication system according to claim 24,  
25 wherein the main station further comprises:

a plurality of signal receiving means corresponding to the respective sub-stations, for receiving all signals to be input to the local area which are output from the respective access relay apparatuses; and

5        a signal transmitting means provided between each of the sub-stations and each of the signal receiving means, for transmitting all of the signals to be input to the local area which have been output from the respective access relay apparatuses and have been received by the respective corresponding signal receiving  
10 means, to the corresponding sub-station.

42. A main station, provided between a plurality of sub-stations for forming respective wireless communication areas in a local area and performing wireless communication with a  
15 wireless communication terminal in the respective wireless communication areas, and one or more access relay apparatuses for outputting a signal to be input from an outside of the local area to an inside of the local area, the main station comprising:

20        a managing means for managing a communication route from each of the access relay apparatuses to each of the sub-stations in a state such that the communication route can be set; and

25        a selecting means for selecting and outputting the signal to be input to the local area which has been received by the access relay apparatuses, in accordance with the communication routes managed by the managing means.

43. A main station, provided between a plurality of sub-stations for forming respective wireless communication areas in a local area and performing wireless communication with a wireless communication terminal in the respective wireless communication areas, and one or more access relay apparatuses for outputting a signal to be input from an outside of the local area to an inside of the local area, the main station comprising:

a signal receiving means for receiving the signal to be input to the local area which has been received by the access relay apparatus; and

a selecting means for selecting and outputting the signal to be input to the local area which has been received by the access relay apparatus, to all of the sub-stations.

44. A sub-station for use in a wireless communication system, wherein the sub-station forms a wireless communication area in a local area, and communicates with a wireless communication terminal present in the wireless communication area formed by the sub-station,

in the wireless communication system, a signal to be input from an outside of the local area to an inside of the local area is converted to a signal form for use in the local area, and is selected and output to the corresponding sub-station,

the sub-station comprising:

a signal receiving means for receiving a corresponding signal among the selected and output signals,

a radio wave signal transmitting means for transmitting the signal received by the signal receiving means to the corresponding wireless communication terminal present in the wireless communication area in the form of a wireless radio wave.

45. The sub-station according to claim 44, wherein the signal to be input from the outside of the local area to the inside of the local area is converted to a signal in an optical signal form, and the optical signal is selected and output,

the signal receiving means receives the signal converted to the optical signal form,

the sub-station further comprises an electrical conversion means for converting the signal received by the signal receiving means to an electrical signal form, and

the radio wave signal transmitting means transmits the signal converted by the electrical conversion means to the wireless communication terminal in the form of a wireless radio wave.

46. The sub-station according to claim 44, wherein the wireless communication terminal transmits a signal to be output from the inside of the local area to the outside of the local area in the form of a wireless radio wave,



the sub-station further comprises:

a radio wave signal receiving means for receiving the signal transmitted by the wireless communication terminal; and

a signal transmitting means for transmitting the  
5 signal received by the radio wave signal receiving means to an outside of the wireless communication area formed by the sub-station.

47. The sub-station according to claim 46, further  
10 comprising an optical conversion means for converting the signal received by the radio wave signal receiving means to an optical signal form, wherein

the signal transmitting means transmits the optical signal converted by the optical conversion means to the outside of the  
15 wireless communication area formed by the sub-station.

48. The sub-station according to claim 46, further comprising a crosstalk canceling means for creating a signal having the same intensity as that of crosstalk occurring in the signal  
20 to be output from the inside of the local area to the outside of the local area due to an influence of the signal to be input to the local area, based on the signal to be input to the local area, and inverting the signal having the intensity and adding the inverted signal to the crosstalk.

49. The sub-station according to claim 48, wherein the crosstalk canceling means comprises:

a first coupler section for splitting a portion of the signal to be input to the local area; and

5 a second coupler section for combining the portion of the signal to be input to the local area which has been split by the first coupler section, with the signal to be output from the inside of the local area to the outside of the local area,

the first coupler section changes a phase of a signal to  
10 be output to the second coupler section by  $90^\circ$  when splitting the signal to be input to the local area, and

the second coupler section changes a phase of the signal to be input to the local area which has been output from the first coupler section, by  $90^\circ$ , when combining the two signals.

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50. The sub-station according to claim 46, wherein the signal receiving means and the radio wave signal transmitting means are accommodated in a first housing, and the signal transmitting means and the radio wave signal receiving means are accommodated in a  
20 second housing.